

# Game Changing Usage of High-Voltage Power Transmission Systems as Extremely Large Antennas for Space Physical and Geophysical Remote Imaging Project

Completed Technology Project (2013 - 2015)



## Project Introduction

We use the US high-voltage power transmission system as an extremely large antenna to extract unprecedented spatiotemporal space physical and geological information from distributed geomagnetically induced current (GIC) observations. The power grid impacts are presently the highest space weather concern in US and Federal Energy Regulatory Commission's ongoing regulatory action will drive substantial industry and federal interests in the GIC problem in the near future. Consequently, the game changing GIC observations set up offers not only opportunity for new big heliophysics science utilizing industrial structures but also potential for major interagency and public-private collaborations.

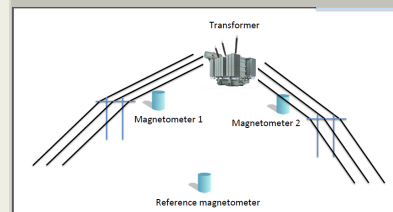
Geomagnetic storms drive geomagnetically induced currents (GIC) in high-voltage power transmission systems worldwide. GIC distribution in the transmission system is a function of the large-scale surface geoelectric field and DC characteristics of the transmission system. Geoelectric field carries information about magnetospheric-ionospheric electric current systems and geological structures. It is common to use information about magnetospheric-ionospheric electric current systems or geomagnetic field variations on the ground together with geological and transmission system description to model GIC. However, no work or technology exists for inverting spatiotemporal space physical and geological information from extensive distributed GIC observations.

We will utilize the US high-voltage power transmission system for the first time as a science tool to map large scale GIC's. Large-scale application of the set up will allow unprecedented, game changing, extraction of space physical and geological information over wide range of spatial and temporal scales. Further, the new GIC observation set up can be turned into a valuable resource for the power transmission industry. We envision that the large-scale implementation of the concept can be carried out in collaboration with the industry and other federal agencies after the second year medium deployment phase. With sufficient funds, full-scale implementation of the concept with a larger number of GIC observation sites can be achieved within 3-4 years after the medium scale deployment phase.

## Anticipated Benefits

The new technology allows extraction of space physical and geophysical research information from the observed GICs. This unprecedented spatiotemporal space physical information can be used to assist the analysis of data from NASA heliophysics missions.

The potential application for this technology is the real-time monitoring of



Schematic Illustration

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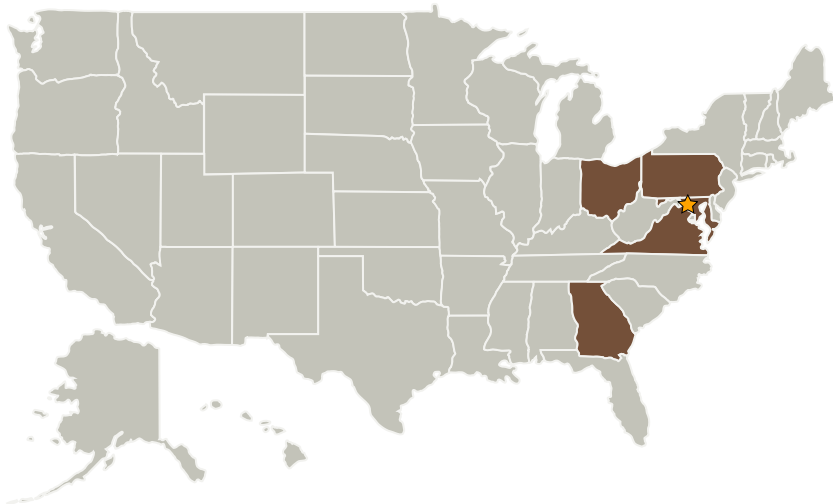
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large-scale GIC distribution in the US power grid. Real-time information about GIC is of interest also, for example, to NOAA, DHS and DOE.

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Co-Funding Partners	Type	Location
American Electric Power	Industry	
Dominion Virginia Power	Industry	Virginia
PJM Interconnection LLC(PJM)	Industry	Norristown, Pennsylvania
Southern Company	Industry	

## Organizational Responsibility

### Responsible Mission Directorate:

Mission Support Directorate (MSD)

### Lead Center / Facility:

Goddard Space Flight Center (GSFC)

### Responsible Program:

Center Independent Research & Development: GSFC IRAD

## Project Management

### Program Manager:

Peter M Hughes

### Project Manager:

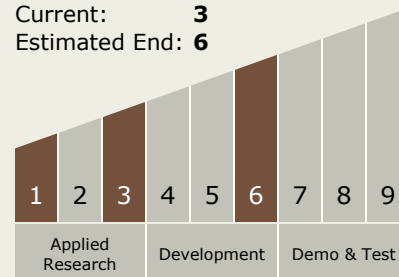
Stanley D Hunter

### Principal Investigator:

Antti A Pulkkinen

## Technology Maturity (TRL)

Start: 1  
Current: 3  
Estimated End: 6



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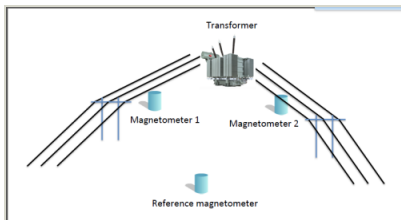
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## Primary U.S. Work Locations

Georgia	Maryland
Ohio	Pennsylvania
Virginia	

## Images



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Schematic Illustration

(<https://techport.nasa.gov/image/4000>)

## Project Website:

<http://sciences.gsfc.nasa.gov/sed/>

## Technology Areas

### Primary:

- TX03 Aerospace Power and Energy Storage
  - └ TX03.3 Power Management and Distribution
    - └ TX03.3.2 Distribution and Transmission